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# PLANT PROTECTION BULLETIN

A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

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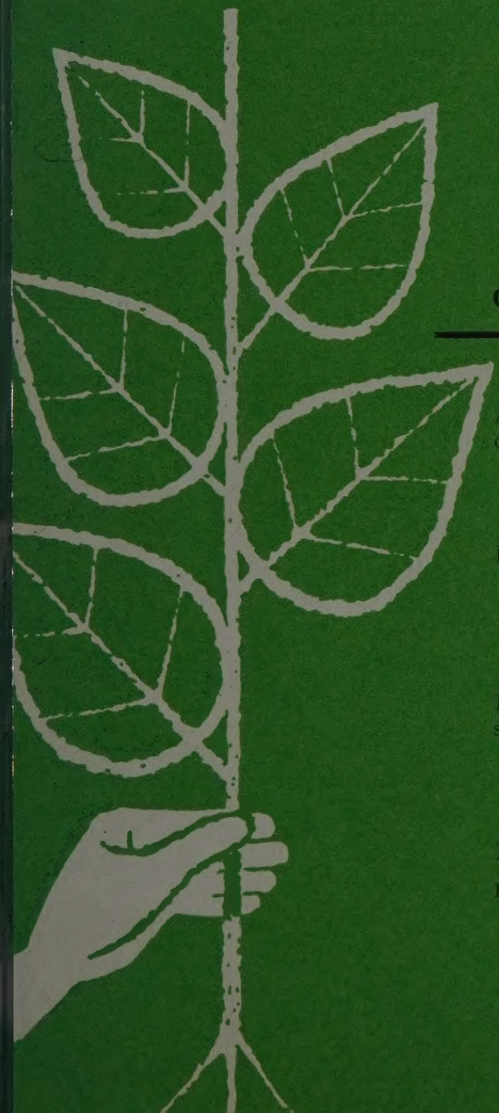

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FAO PLANT PROTECTION BULLETIN

is issued as a medium for the dissemination of information received by the World Reporting Service on Plant Diseases and Pests, established in accordance with the provisions of the International Plant Protection Convention, 1951. It publishes reports on the occurrence, outbreak and control of pests and diseases of plants and plant products of economic significance and related topics, with special reference to current information. No responsibility is assumed by FAO for opinions and viewpoints expressed in the Bulletin.

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Vol. 9, No. 3 - DECEMBER 1960

FAO PLANT PROTECTION BULLETIN

A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

# A Review of Treatments of Citrus Fruits for Control of Mediterranean Fruit Fly

*Frederic P. Hubert*, Regional Insect Control Project, American Embassy, Beirut, Lebanon

One of the insect pests causing the greatest damage to citrus fruits in infested areas is the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) It is likewise one of the most troublesome to both importers and exporters. While direct damage to fruits by this pest in the egg and larval stages may be extremely high, the situation is far more serious in international trade, since infestation may cause importing countries to reject entire shipments, or worse, may lead to the loss of markets. This paper, which was originally given as a lecture at the FAO Training Center on Fruit and Vegetable Marketing, held in Cairo, in February 1960, presents a review of treatments to kill the Mediterranean fruit fly in citrus fruits, with special reference to ethylene dibromide fumigation.

## Methods of treatment other than fumigation

In considering various treatments for the eradication of Mediterranean fruit fly, although emphasis is to be placed on fumigation, there are a number of other methods of treatment developed either recently or years ago, which should be mentioned.

### Seasonal harvesting

The simplest method of avoiding infestation of the Mediterranean fruit fly in citrus shipments is to harvest the citrus fruit before emergence of the fly. In some countries, the fruit is cut, packed and shipped before the flies invade the groves late in the season. Unfortunately, this method has no value, first, for the late varieties of citrus as, for example, Valencias, and second, for areas where the Mediterranean fruit fly is present in the citrus grove throughout the year.

### Field control

Field application of insecticides in the citrus groves to kill the Mediterranean fruit fly is highly desirable and necessary. Unfortunately, such field control is normally not effective enough to make treatment of the fruit before export unnecessary. Field control, if properly applied, greatly reduces the number of eggs and larvae of the Mediterranean fruit fly but usually does not eliminate them completely from fruit shipments. Field control in citrus groves is not to be confused with eradication campaigns involving both cultivated and wild hosts.

### Vapor heat treatment

One of the earlier methods developed for killing the Mediterranean fruit fly in citrus fruit is by a combination of heat and humidity. This vapor-heat process to kill the eggs and larvae can be used in two ways. One requires that the temperature of the center of the fruit

be raised to 110° F. (43° C.) within 8 hours and held at that point for 8 3/4 hours. The other method, known as "quick run-up," is to raise quickly the temperature of the center of the fruit to 117° F., but does not require the holding period of 8 3/4 hours.

In both methods, the latent heat in the saturated vapor is transferred to the citrus fruit under treatment. The fruit takes up the heat released by condensation of the heated vapor. The best results have been obtained when the raising of the temperature of the citrus fruit is done both evenly and quickly. Carelessness in using either one of the vapor-heat methods may cause damage to the fruit and heavy losses. It should be noted that dry heat invariably damages citrus fruit as well as other fruit and vegetables. While both kinds of vapor-heat treatments are in use, some exporters prefer other methods of treatment, due to the danger of injury.

### Cold treatment

One of the older and best methods to kill the eggs and larvae of the Mediterranean fruit fly in citrus and other fruits has been the low temperature or cold treatment. Under this method, it is first necessary to lower the temperature within the fruit by a precooling period of refrigeration. When the required temperature is reached, the fruit shipments are then held at specified temperatures for a required number of days. For example, after precooling to 32° F. (0° C.), if the fruit is held under a constant temperature of 32° F. or below, all eggs and larvae of the Mediterranean fruit fly are killed in ten days.

The processes involved can all be done simultaneously in refrigerated warehouses. After precooling, the fruit shipments can be quickly transferred to either refrigerated ships or refrigerated space in general cargo ships. Here, at specified low temperatures, the citrus shipment can be treated to "sterilize" the fruit en route to its destination. A thermograph should be used to record the temperatures of the fruit and establish that the treatment was made at the prescribed temperature for the indicated duration.

### Ethylene dibromide tank dip method

One of the latest and very promising methods of treatment which has been investigated intensively in Mexico, Hawaii and Israel, is a tank dip using ethylene dibromide (EDB). One dip treatment utilizes ethylene dibromide with a light oil and an emulsifier so that it will readily mix in a washing tank. The fruit must remain in the tank from three to four minutes but no longer, due to danger of burning. The ethylene dibromide concentration should be maintained at 1.5 to 2.0 grams per liter while the fruit passes through the copper tank. The equipment used is somewhat complicated and it will not be described here.

Another dip treatment for papayas and other fruit in Mexico and Hawaii requires 20 minutes submersion in a dilute concentration of 1 part ethylene dibromide in 20,000 parts water heated to 115° F. Very little of the fumigant is needed in the heated dip, which also delays development of storage rots in papaya.

Some of the advantages of the ethylene dibromide tank dip method, which is now being used in at least one Mediterranean country, include first, a considerable saving of time over the fumigation method, and second, with the addition of borax to the dip, the simultaneous killing of scale insects on the fruit. Some of the disadvantages are that certain species and varieties of citrus fruits are very sensitive to ethylene dibromide in the tank dip, and that the operation of the equipment requires a highly trained technician.

### Ethylene dibromide fumigation

Methyl bromide gas, has been used in the treatment for the Mediterranean fruit fly on certain vegetables, such as bell peppers, cucumbers, pink and red ripe tomatoes. However, it causes severe burning to citrus fruit under certain circumstances. Therefore, methyl bromide gas cannot be recommended for treatment of citrus.

Ethylene dibromide gas, discussed earlier in the tank dip method, is also used as a fumigant in atmospheric chambers to kill the Mediterranean fruit fly. This fumigation method is, or has been, widely used in certain citrus-

growing areas in the United States, particularly Florida and Texas. It is currently used in Cyprus in the Mediterranean area and has been adopted by several countries in the West Indies and Mexico.

### Characteristics and properties of ethylene dibromide

Ethylene dibromide gas is recommended for the treatment of citrus and certain other fruit infested with the fruit fly. This fumigating gas is colorless like chloroform and practically odorless, and has a low solubility in water. Its deterioration in light is very slow and, when volatilized, it forms a vapor. There is no danger of fire from this fumigant.

Ethylene dibromide has a boiling point of 264° to 269° F. and a specific gravity of 2.150 to 2.190 at 70° to 79° F. There is no flash point or fire point, in contrast to many other fumigating gases.

### Toxicity to human beings

Ethylene dibromide is toxic to human beings if in contact with the fumes or the liquid itself. A doctor should be called at once if a person has inhaled ethylene dibromide, absorbed it through the skin, or accidentally swallowed it. An inhalation of 300 parts of ethylene dibromide per million of air in one tenth of an hour is considered toxic to man, or 25 p.p.m. as the threshold for continuous exposure. Extreme care must be exercised to avoid contact with the fumes or liquid.

### The fumigating chamber

The chamber to be used for fumigating citrus fruits with ethylene dibromide gas is of the atmospheric type. The construction may be of concrete, tile or brick with plastered walls and ceiling, or it may be of frame construction, lined with gas-impervious material. In general, the chamber should be 1½ times as long as it is wide, and the ceiling should be 8 to 10 feet high. A chamber of 20 × 30 × 10 feet will accommodate the equivalent of two carloads of oranges.

The doors of the chamber must be next to the processing machinery and of sturdy construction. They should close on a refrigerator-type gasket and be clamped during fumigation with locking lugs to prevent escape of the gas vapor. The liquid ethylene dibromide is volatilized in either an open enamel or stainless steel (not aluminum) container over an electric hot plate. This must be mounted in the air stream of the duct system and must be visible from outside the chamber through a gastight view plate. The electric switches for control of the hot plate, light bulb and room circulation blower are necessarily located outside the chamber near the glass view plate.

All nonmetal surfaces on the interior of the fumigation chamber should be painted twice with a special chemical-resistant coating. All cracks, seams, joints or other openings in the chamber interior must also be sealed airtight with plaster of Paris, plastic cement or similar compound.

The specifications of the circulation system require a motor and blower, a false floor, delivery duct, baffle plate, return duct and exhaust vent. A motor-driven, rotary-type blower sufficient to change the air once per minute is required for this treatment.

### Fumigation treatment

Without going into further detail, the ethylene dibromide fumigation is accomplished by heating the liquid until it becomes a vapor. The fumigant must be volatilized in not less than 15 to 30 minutes after the point of boiling. The vapor is then mixed with the air stream so as to circulate the chamber in one minute. The gas is circulated for the treatment or holding period. The period of treatment is two hours, beginning from the time the ethylene dibromide is completely volatilized. The blower should be operated continuously throughout the volatilization, holding and exhausting period. The dosage rate per 1,000 cubic feet for the two-hour holding period depends on the percentage of load in the chamber and the temperatures of the fruit and room. In the case of citrus fruit, the load should not exceed

80 percent of the capacity of the treating chamber, but it may be lower.

Steam radiators are used to bring the citrus fruit as well as the room to required temperatures. Less fumigant is needed at higher temperatures. One schedule recommends for citrus 10 ounces of ethylene dibromide per 1,000 cubic feet of space at 70° to 76° F., but only 8 ounces at 77° F. and above.

### Advantages and disadvantages

The ethylene dibromide fumigation method is considered one of the better methods of treating citrus to kill the Mediterranean fruit fly as well as other fruit fly pests. Some of the advantages are that first, it is less expensive than other treating methods, and second, it is a quicker method of treatment than other systems, apart from the ethylene dibromide tank dip method.

The ethylene dibromide treatment also has disadvantages. As it is a toxic chemical, due care must be exercised in its use. However, nearly all fumigants are toxic and ethylene dibromide is not more so than others. It is also reported by Polacek[1] that leafhopper injury is increased after ethylene dibromide fumigation, the degree of increase depending on the species and variety of citrus fruit.

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[1] Polacek, K. 1958. Report to the Government of Cyprus on the fumigation of citrus fruit and other foodstuff. FAO Report No. 978. (mimeographed)

# Internal Spotting, a New Disease of Coconut[1]

*Karl Maramorosch*, Rockefeller Institute, New York, *Hans Rothkirch*, Franklin Baker Company, San Pablo Laguna, Philippines, and *Bernardo S. Castillo*, Bureau of Plant Industry, Manila

A previously unknown disorder of coconut was discovered in the Philippines recently, when an alarmingly high percentage of nuts were found unsuitable for desiccation and had to be discarded on the assembly lines of the Franklin Baker Company of the Philippines, in San Pablo, Laguna. The shipments of unsuitable nuts were traced to several localities on the island of Mindoro Oriental. Only a narrow strip of the coastal area on this large island has been under cultivation, and permanent settlements were started there only after 1920 because of the high incidence of fatal malaria. The vast interior of the island, although fairly close to densely populated parts of Luzon, still remains unexplored. The existing coconut plantations on Mindoro are among the highest yielding in the Philippines.

The disorder, which is designated as "internal spotting," is not easily discernible. Grayish-dark and yellowish spots are found only on the outer side of the coconut meat after removal of the seed skin (Figure 1). The spots do not penetrate deeper than 2 to 3 millimeters and therefore remain unnoticed

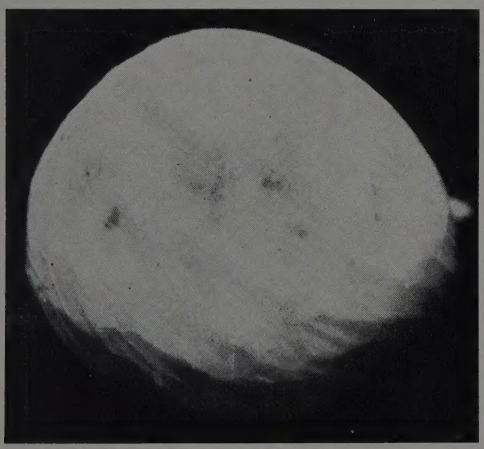

*Figure 1.* Coconut meat, after the outer skin has been peeled off, showing signs of internal spotting.

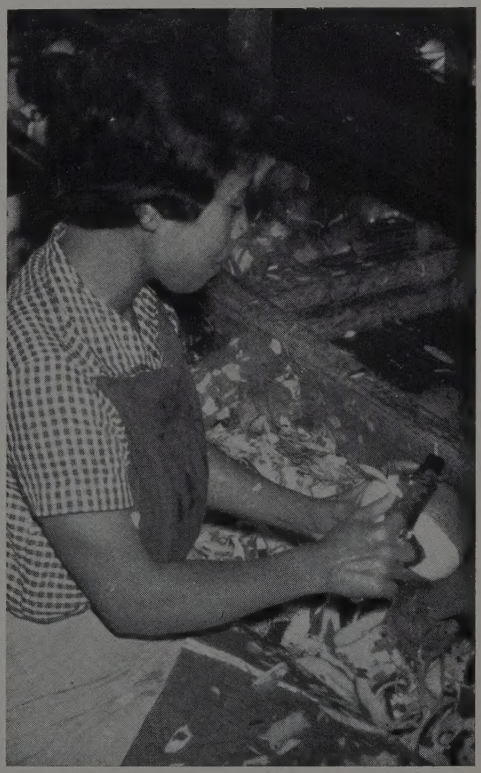

*Figure 2.* The peeling of coconuts at a desiccating plant in San Pablo, Laguna. Note the special knife used for the removal of the outer skin from the coconut meat; the entire meat is lifted in one piece from the shell.

[1] A preliminary report on internal spotting was presented at the 1960 Annual Meeting of the Northeastern Division, American Phytopathological Society, Springfield, Mass., U.S.A.

in unpeeled nuts split for copra. Peeling of the coconut meat is a necessary part of the shredding process in modern desiccating factories (Figure 2) but is not required in the production of copra. Only 5 percent of the total coconut production in the Philippines is used for desiccation and all of this in the San Pablo area. The disease remains unnoticed by growers, copra manufacturers and exporters who handle the remaining 95 percent of the crop.

Spotted nuts are unsuitable for desiccation but can be used for copra, although the oil from such nuts is cloudy and of inferior quality. Samples of nuts from the plantations of S. Enriquez at Malusak, Pinamalayan, from Abelardo Ylagan plantation at Calinisan, Naujan, and from the Kalaw plantation at Palhi, all in Mindoro Oriental, were obtained for inspection. The percentage of "black meat" in the nuts varied in the samples from 11 to 81 percent. It was found that the darker areas of meat contained less oil and more moisture than comparable white areas. Because of the high incidence of internal spotting in Mindoro nuts, shipments from the island for desiccation purposes had to be suspended.

An inspection of plantations on Mindoro in the vicinity of Pinamalayan revealed that certain trees that had a high incidence of internal spotting in 1957 had mostly normal nuts in 1960. Nearby trees had up to 90 percent of spotted nuts.

A preliminary study of nuts from other islands revealed the occasional occurrence of internal spotting in places far removed from Mindoro. It seems likely that internal spotting is a physiological disease or that its manifestation depends on the simultaneous action of a disease agent and of some environmental factors. If the condition responsible for the disappearance of spots in certain trees in Mindoro were determined, the disorder could perhaps be overcome. The high incidence of spotting on Mindoro cannot be explained as yet. Further surveys are needed to establish the incidence of internal spotting in other locations and its possible occurrence in other coconut-growing countries.

# Pear Decline Disease and its Apparent Southward Spread Along the Pacific Coast of North America

*Carl W. Nichols*, Bureau of Plant Pathology, California Department of Agriculture, and *Thomas A. Shella*, Department of Plant Pathology, University of California, Davis, California

In the state of California, United States, an estimated 10,000 pear trees collapsed and were dead by the end of the summer in 1959 (4). In 1960, over 100,000 pear trees either collapsed and died, or declined into a state with little or no terminal growth, remaining in low vigor. Affected pear trees were seen in all the major pear-growing counties in the northern two thirds of the state.

The symptoms of the affected pear trees in California were essentially the same as those reported previously on pear decline-affected trees in the Pacific Coast states of Washington and Oregon (6) and in the adjoining province of British Columbia in Canada (3). Because of this similarity in symptoms, the California pear disorder is considered to be the same as that reported in the above more northern states and province. The cause of the pear decline disorder has not yet been determined.

Pear decline was first described in British Columbia in 1948 (3). It probably was observed in Washington the same year (2), but it has been most apparent there since 1950 (2). The disorder was first reported in Oregon in 1957 (6). The subsequent appearance of the disorder in California in 1959 suggests that pear decline may have spread southward in pear-growing districts along the Pacific Coast of North America.

External and internal symptoms of pear decline are very similar to those observed on cherry trees on mahaleb (*Prunus mahaleb*) rootstocks infected with buck skin virus, or on sweet orange trees on sour orange rootstocks infected with tristeza virus.

External symptoms of the disorder are of two types (2, 4, 6). Trees may either collapse and die within a few weeks, or show reduced vigor and persist in that condition for several years. In the first type, the fruit stops growing and both fruit and leaves suddenly wilt (Figure 1). The wilting is followed by some scorching and then death of the leaves. Death of the tree usually occurs within a few weeks. In the second type of symptoms, foliage is sparse, with little or no terminal growth apparent. Leaves are small and of a light green color. In some instances, in California, the fruit is smaller than that on trees of normal appearance (Figure 2). In the autumn, an abnormal red coloration of the foliage has been observed in association with pear decline-affected trees.

When the graft union of decline-affected pear trees is examined, a brown line is commonly observed on the cambial face of the bark at or directly below the line of union between top and root. In some cases, vertically fluted ridges can be seen on the cambial face at this union. Microscopic examination of the phloem tissue in the area of the graft union shows an abnormal accumulation of callose in the sieve areas of the sieve tubes just below the union, lysis of cell contents, distortion of ray cells, and the abnormal production of new phloem cells. These newly produced cells are often killed shortly after their production (1, 5).

Most of the roots of $^1/_8$ inch diameter or smaller on affected pear trees are dead. Tests of the roots of decline-affected trees show that they have little or no stored foods (4).

*Figure 1.* Bartlett (Williams' Bon Chrétien) pear tree in El Dorado County of California, with wilted leaves and shriveled fruit that are characteristic of the "collapse" or "quick decline" stage of pear decline. (Photograph by C. Clower, California Department of Agriculture.)

*Figure 2.* Bartlett (Williams' Bon Chrétien) pear tree in El Dorado County of California, with sparse foliage and small fruits associated with the "slow decline" stage of pear decline. (Photograph by C. Clower, California Department of Agriculture.)

Most of the affected pear trees have been found to be on *Pyrus ussuriensis*, *P. serotina*, or *P. calleryana* rootstocks. A low percentage of the trees on *Pyrus communis* rootstocks has also been found to be affected. Deeply planted trees that produce roots above the graft union appear to escape the disorder (1, 2, 4, 6). Trees of all commercial pear varieties in California have been seen with symptoms of the disorder.

Investigations to determine the cause of pear decline and to develop methods to counteract its threat are being made by the University of California, California State Department of Agriculture, and the United States Department of Agriculture. The work is coordinated by a University of California Research Committee on Pear Decline, with representatives from the above agencies, as well as from the states of Oregon and Washington, and the pear industry.

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# PLANT QUARANTINE ANNOUNCEMENTS

## BRAZIL

Ministerial Order of 27 September 1960, published in the *Diario Oficial* on 1 October 1960, modifies the requirements for the importation of potatoes. It revokes Ministerial Orders No. 622 of 15 July 1955, No. 811 of 28 August 1955, and No. 986 of 10 November 1955 (see *FAO Plant Prot. Bull.* 5 : 65. 1957).

### Certification

Importation of potatoes is prohibited unless each consignment is accompanied by a phytosanitary certificate issued by the competent service of the country of origin and visaed by the Brazilian Consul at the port of embarkation, stating that in the field of origin *Synchytrium endobioticum, Corynebacterium sepedonicum, Heterodera rostochiensis, Pseudomonas solanacearum* and the necrosis-causing races of virus Y did not occur, and that tubers are free from these pathogens and other dangerous plant diseases and pests.

Certificates for seed potatoes must include, in addition, declarations to the effect that the tubers originate from fields especially established for seed production, that fields and potatoes were officially inspected for virus and other diseases, and that the tubers were certified according to seed potato standards of the country of origin.

### Quality and packing requirements

The import of seed potatoes of the type *Anerkannter Nachbau* or its equivalent is prohibited.

The import on a commercial scale of potato varieties considered unfit for growing in the country is also prohibited and a list of such varieties and their origin will be published each year before 31 July.

The Plant Protection Division will establish criteria for potato inspection, tolerance limits of pests and diseases and treatments. Potatoes destined for importation must be clean without excessively long sprouts and must not be soft or misshapen. The size must be within the range of 30 to 60 millimeters ; the presence of larger tubers up to 65 millimeters may be tolerated up to 20 percent by weight.

Seed potatoes must be packed in special crates or boxes containing not more than 30 kilograms and clearly marked " Certified Seed Potatoes " in Portuguese, English, French or German. The name of the variety and the certification grade must also be indicated.

## GUATEMALA

An Executive Order of the Ministry of Agriculture of 9 March 1960, published in the *El Guatemalteco* Vol. 158 No. 65 on 28 March 1960, adds Nicaragua to the list of countries from which no agricultural products that might harbor the Mediterranean fruit fly (*Ceratitis capitata*) may be imported into Guatemala (see *FAO Plant Prot. Bull.* 4 : 173. 1956). This Order is based upon a report of the Organismo Internacional Regional de Sanidad Agropecuaria, stating that Mediterranean fruit fly has invaded the territory of Nicaragua.

## NETHERLANDS

Order No. J. 1721 of 12 August 1960, published in the *Nederlandse Staatscourant* No. 155 on 12 August 1960, governs the importation of certain plant materials. It came into force on 1 September 1960, except the provisions governing tulip and narcissus bulbs, which will come into effect on 1 September 1961.

The new Order replaces the San José Scale Order of 1953 (see *FAO Plant Prot. Bull.* 1 : 124. 1953), the Importation of Soils Order of 1954 (see *FAO Plant. Prot. Bull.* 2 : 158. 1954), the Importation of Strawberry Plants Order of 1958 (see *FAO Plant. Prot. Bull.* 6 : 108. 1958), the Importation of Tulips Order of 1958 (see *FAO Plant. Prot. Bull.* 7 : 31. 1958), and the Importation of Flower Bulbs Order of 1960.

The importation of plant materials mentioned below is permitted only if the prescribed requirements are fulfilled. The importation of soil as packing material for plants (except root balls) from the United States and Japan is prohibited. The head of the Netherlands Plant Protection Service may grant exceptions from the restrictions or issue special directives.

**General requirements**

Each consignment must be accompanied by a phytosanitary certificate issued by the country where the produce was grown, in the form annexed to the International Plant Protection Convention of 1951. If the exporting country is not the country where the produce was grown, the consignment must be accompanied, in addition to the phytosanitary certificate or authenticated photocopy thereof, by a declaration of the plant protection service of the exporting country to the effect that the consignment is still considered to conform to the Netherlands phytosanitary requirements.

**Special requirements**

1. Potatoes. The consignment must be free from wart (*Synchytrium endobioticum*) and ring rot (*Corynebacterium sepedonicum*) and the tubers must originate from a field where these diseases have not been observed during the preceding 20 years.

2. Strawberry plants. The consignment must be free from red core (*Phytophthora fragariae*). If this disease occurs in the country of origin, the plants should be derived from mother plants officially examined in the field during growth and found to be free from the disease.

3. Tulip and narcissus bulbs. The consignment must be free from stem and bulb eelworm (*Ditylenchus dipsaci*). If this pest occurs in the country of origin, the plants from which the bulbs were derived must have been officially examined in the field during growth and found to be free from the eelworm.

4. Living woody plants (excluding Coniferae and Ericaceae) and parts thereof, except fruits, seeds and cut flowers. The consignment must be free from San José scale (*Quadraspidiotus perniciosus*). Plants of the genera *Acer, Cotoneaster, Crataegus, Cydonia, Euonymus, Fagus, Juglans, Ligustrum, Malus, Populus, Prunus, Pyrus, Ribes, Rosa, Salix, Sorbus, Syringa, Tilia* and *Ulmus* will be fumigated on arrival. During the period 1 April to 1 October, the importation or transit of living woody plants is prohibited. (Additional requirement for the importation of woody plants is provided in Order No. JP 940 of 15 December 1960, published in the *Nederlandse Staatscourant* No. 245 of 16 December 1960. The consignment must be free from fire blight, *Erwinia amylovora*. If the disease occurs in the country of origin, the plants must be officially examined in the field during the growing season and found to be free from the disease.)

5. Fruits. Consignments of apricots, apples, pears, peaches and plums must be free from San José scale. Citrus must be free from Mediterranean fruit fly (*Ceratitis capitata*). Cherries must be free from cherry fly (*Rhagoletis cerasi*).

Stabilimento Tipografico Fausto Failli - Via Tuscolana, 128, Roma

# IMPORTANT NOTICE

In order to make each volume coincide with the calendar year and to overcome the difficulty of accommodating longer articles in a monthly periodical of the present size, the *FAO Plant Protection Bulletin* will be published bimonthly in 1961, with Volume 9 covering the period from October 1960 to December 1961 in nine numbers, as follows :

Volume 9, No. 1 - October 1960
" 2 - November 1960
" 3 - December 1960
" 4 - February 1961
" 5 - April 1961
" 6 - June 1961
" 7 - August 1961
" 8 - October 1961
" 9 - December 1961

After the change to a bimonthly publication, each issue will be equivalent in size to at least two monthly issues. Subscribers will receive all nine issues of Volume 9 without additional charge.

To facilitate the speedy exchange of information, advance reports concerning outbreaks and the spread of important plant pests and diseases, as well as plant quarantine announcements, will be issued in mimeographed form and sent to the national plant protection services of countries concerned before publication in the Bulletin.

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